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BRITISH MUSEUM (NATURAL HISTORY)

THE

JOHN MURRAY EXPEDITION

1933–34

SCIENTIFIC REPORTS

VOLUME IV. No. 4

CRINOIDEA

BY

AUSTIN H. CLARK

(National Museum, Washington, D.C., U.S.A.)

WITH ONE PLATE

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. Quaritch, Ltd., 11 Grafton Street, New Bond Street, London, W. 1; Dulau & Co., Ltd., 29 Dover Street, London, W. 1; Oxford University Press, Warwick Square, London, E.C. 4
AND AT
The British Museum (Natural History), Cromwell Road, London, S.W. 7
1936

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Price Two Shillings

[*Issued 1st January*, 1937]

DESIGNED AND
PRINTED
BY
ADLARD & SON, LTD.
21, HART STREET, W.C.
AT
BARTHOLOMEW PRESS
DORKING

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National Museum, Washington, D.C., U.S.A.

WITH ONE PLATE.

The British Museum, through Mr. D. Dilwyn John, has done me the honour of requesting me to report upon the Crinoidea collected by the John Murray Expedition to the Indian Ocean, 1933–1934. The opportunity for studying this collection, so kindly offered, was greatly appreciated, for the Indian Ocean is a region very imperfectly known so far as its crinoids are concerned. Here crinoids are poor in species and few in individuals, and the existing records are far from satisfactory.

The present collection adds much to our knowledge of the systematic status and of the distribution of several species, and by supplementing the information already available, makes it possible for the first time to describe, with the probability of a reasonable degree of accuracy, the faunal interrelationships of the different portions of the Indian Ocean.

The species collected by the Expedition were :

Stephanometra spicata.
S. indica.
Lamprometra klunzingeri.
Colobometra arabica sp. nov.
Oligometra occidentalis.
Tropiometra magnifica sp. nov.
T. audouini.
Crotalometra sentifera.
Cosmiometra leilæ.
Thalassometra attenuata.
Repometra arabica gen. et sp. nov.
Psathyrometra mira.
Caryometra robusta sp. nov.
Fariometra sewelli sp. nov.
Pentametrocrinus varians.
Thaumatocrinus sp.

It is worthy of note that of sixteen species collected, five—roughly 30%—proved to be new, one of these representing a new genus.

All the crinoids known from the Indian Ocean were mentioned in 'The Crinoids of the Indian Ocean' (A. H. Clark, 1912*c*), and all the comatulids were included in 'The Unstalked Crinoids of the "Siboga" Expedition' (A. H. Clark, 1918). All the crinoids known from the African coasts are given in 'The Recent Crinoids of the Coasts of Africa' (A. H. Clark, 1911*a*). Since these contributions appeared a number of additional records have been published, and certain changes have been made in the synonymy of some of the species. It has seemed advisable, therefore, to include herein a list of all the crinoids at present known from the seas west of Ceylon and the west coast of India.

ANNOTATED LIST OF SPECIES.

Suborder OLIGOPHREATA A. H. Clark.

Superfamily MARIAMETRIDA Gislén.

Family Mariametridæ A. H. Clark.

Stephanometra spicata (P. H. Carpenter).

Antedon spicata, P. H. Carpenter, 1881, p. 190.
Stephanometra spicata, A. H. Clark, 1918, p. 95.

Locality.—Station 10 ; Red Sea ; 55 metres. One specimen.

Range.—From the Macclesfield Bank and the Philippine Islands to the Pelew and Caroline Islands, New Guinea, the Admiralty and Solomon Islands, Fiji, the Loyalty Islands and Torres Straits, and westward to the Red Sea ; from the shore-line down to 55 (? 64) metres.

Notes.—The specimen has 20 arms 105 mm. long. The two remaining cirri have 18 and 20 segments ; the longest is 16 mm. long. P_3 may resemble P_2 and be of the same size, though usually it is smaller, or it may be more or less reduced and weak, resembling, or approximating in appearance, P_4. P_2 is composed of 17 segments, and is slender and delicate distally instead of stout and spine-like as usual. This specimen is more or less intermediate between *spicata* and *indica*, though more like the former.

Remarks.—This is the first record for this species in the Red Sea.

Stephanometra indica (E. A. Smith).

Comatula indica, E. A. Smith, 1876, p. 406 ; 1879, p. 564, pl. 51, figs. 3 *a*, *b*.
Antedon marginata, Chadwick, 1908, p. 45.
Stephanometra indica, A. H. Clark, 1918, p. 97.

Localities.—Station 10 ; Red Sea ; 55 metres. Fragments of two specimens.

M.B.I*d*.—Red Sea ; 26 metres. One specimen.

Range.—From the Macclesfield Bank and the Philippine Islands to the Caroline and Marshall Islands, Samoa, Fiji, the Tonga Islands, New Caledonia, and Torres Straits, and westward to Madagascar, the Seychelles, and the Red Sea ; from the shore-line down to 62 (? 73) metres.

There are two forms of this species—typical *indica*, which occurs in the western Indian Ocean, at Ceylon, and in Torres Straits, and an eastern form, *protectus*, in which P_2 is stouter and stiffer, with fewer segments, which is found from Ceylon eastward. The two forms are found together at the Maldive Islands and Ceylon, and in Torres Straits.

Notes.—The specimen from Station M.B.I*d*. has 20 arms ; the cirri have 17–18 segments ; P_2 is 7 mm. long, with 14–16 segments, and becomes slender and delicate terminally ; on one arm P_3 resembles P_2. The two other examples are represented only by arm fragments and a detached disc.

Remarks.—Originally described in 1876 by Mr. E. A. Smith from a specimen collected by Mr. H. H. Slater at Rodriguez, this species was later (1908) recorded by

Mr. H. C. Chadwick from Suez Bay under the name *marginata*, and again (1909) by Prof. F. Jeffrey Bell from north reef, Farquhar Atoll, under the name *palmata*. In 1911 and 1912 I added several more localities to its known range. I have personally examined all the known specimens of the species.

Heretofore two closely related species, *Stephanometra indica* (E. A. Smith) and *S. protectus* (Lütken) (= *Antedon monacantha* Hartlaub) have been recognized. Since both occur together at Ceylon and in Torres Straits, and intergrading specimens are found, I believe that these represent simply two forms of a single variable specific type.

The more generalized form, *indica*, occupies the entire western portion of the range of the species, and is also found on the south central limit of the range (northern Australia). Over the remaining portion of the range only the more specialized form, *protectus*, occurs. Though very variable, this is always readily distinguishable from *indica*.

Lamprometra klunzingeri (Hartlaub).

Comatula leucomelas, Leuckart, 1833, pp. 387, 390 (*nomen nudum*).
Alecto palmata (in part), J. Müller, 1841, p. 144.
Antedon klunzingeri, Hartlaub, 1890, p. 175 ; 1891, p. 46, pl. 2, figs. 22, 25.

Locality.—Station 56 ; South Arabian coast ; 421 metres. One specimen.

Range.—Red Sea and eastward to Muscat ; the records for Zanzibar and Dar-es-Salaam require confirmation. Littoral.

Notes.—The single specimen is very small.

Remarks.—This is a littoral species, and its occurrence in 421 metres of water is very interesting. There is a possibility that it was swimming at or near the surface and was intercepted by the net. Some crinoids are active swimmers, especially when young, and there are a few records of individuals having been captured in tow-nets in a calm sea.

This species has usually gone under the name of *palmata*. But it is evident from Müller's original description and from the locality he gave (" India," probably the Dutch East Indies) that his species was the common eastern representative of the genus (see *Lamprometra palmata*, p. 100). The next available name is Hartlaub's *klunzingeri*.

Family Colobometridæ A. H. Clark.

Colobometra arabica sp. nov. (Plate I, fig. 2.)

Locality.—Station 10 ; Red Sea ; 55 metres. One specimen.

Characters.—The cirri are 20–23 mm. long with 35–40 segments. The three or four segments before the penultimate have single median dorsal spines, these being paired on the segments preceding. P_1 is small and weak, 5 mm. long, with 14–15 segments. P_2 is 8·5 mm. long, with 14 segments. The pinnules following resemble P_2, but slowly decrease in length.

Remarks.—This new species resembles very closely *C. suavis*, known from a single specimen from the Philippine Islands, but it is easily distinguished by the fact that the spines on the cirri are double until near the tip.

Oligometra serripinna var. *occidentalis* A. H. Clark.

Oligometra serripinna var. *occidentalis*, A. H. Clark, 1911*a*, p. 33.

Localities.—Station 10 ; Red Sea ; 55 metres. Fragments of one specimen.

Station 27 ; Gulf of Aden ; 37 metres. Two specimens.

Station 45 ; South Arabian coast ; 38 metres. Two specimens.

Range.—From the Red Sea and the southern coast of Arabia southward to Mauritius and Cargados Carajos ; 0–55 metres. This form occurs as an occasional variant eastward.

Notes.—The specimen from Station 10 consists of arm fragments from a large individual.

One of the specimens from Station 27 has the arms 55 mm. long and the cirri XIV, 14–15. P_2 has 13 segments, the outer with the prismatic angles very slightly produced. The other specimen from Station 27 has the arms 50 mm. long and the cirri XI, 13–14. P_2 has 12 segments, the outer with a very slight production of the prismatic angles.

Both of the specimens from Station 45 are small, and in both P_a is absent. One of them has the arms 25 mm. long. They are described, in a note made at the time of capture, as having been pulled off red Gorgonids.

Superfamily TROPIOMETRIDA A. H. Clark.

Family Tropiometridæ A. H. Clark.

Tropiometra magnifica sp. nov. (Plate I, fig. 1.)

Locality.—Station 24 ; Gulf of Aden ; 73–220 metres. One specimen.

Description.—The centrodorsal is thick discoidal, 9 mm. in diameter at the base with a broad convex dorsal pole 7 mm. in diameter. The cirrus sockets are arranged in two crowded alternating more or less irregular marginal rows.

The cirri are XXV, 35–37, the longest, about the periphery of the centrodorsal, 60–65 mm. long. The first segment is very short, the second is about three times as broad as long, and those following gradually increase in length to the eighth, which is about as long as broad, and the eleventh, which is somewhat longer than broad. The segments following are similar, the distal becoming slightly shorter, so that the last 12 or 14 are about as long as broad, and the last two slightly broader than long. The segments in the outer half of the cirri are slightly compressed laterally and faintly carinate in the mid-dorsal line. The longer earlier segments may be slightly constricted centrally. The opposing spine is minute and terminal, or altogether absent. The terminal claw is somewhat longer than the penultimate segment, rather stout, and moderately curved.

The radials project slightly beyond the rim of the centrodorsal. Their distal edge is slightly and regularly concave, so that they are about twice as long in the interradial angles as in the midradial line. The IBr_1 are very short, 6–7 times as broad as long, with the proximal and distal edges nearly straight and parallel, and the lateral edges slightly divergent and slightly convex. The IBr_2 (axillaries) are triangular with slightly truncated lateral angles, and aretwice as broad as long. The anterior angle is somewhat greater than a right angle, and is a little grooved at the apex. The lateral borders of the IBr series and first two brachials are straight and are almost or quite in contact with those of their neighbours.

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The 10 arms are 265 mm. long. The first brachials are wedge-shaped, about twice as long exteriorly as interiorly, nearly four times as broad as the median length, with the proximal and distal edges straight and parallel and the inner edges united basally, diverging at a right angle distally. The second brachials are similar to the first, but the proximal and distal ends are slightly more oblique. The first syzygial pair (composed of brachials 3 + 4) is oblong, nearly twice as broad as long. The brachials following are wedge-shaped, with the longer side more than twice as long as the shorter, and about twice as broad as the greater length ; after the sixteenth the brachials become triangular, with the proximal and distal edges somewhat sinuous, half again as broad as long. After the proximal fourth of the arm the brachials slowly become shorter, with the ends less oblique, in the middle of the arm being wedge-shaped and twice as broad as long. Distally the obliquity of the ends still further decreases, and terminally the brachials increase in length, becoming as long as broad.

Syzygies occur between brachials 3 + 4 and 9 + 10, from between brachials 11 + 12 to between brachials 15 + 16 (usually between brachials 14 + 15), and distally at intervals of from 6 to 9 (usually 7 or 8) muscular articulations. On one arm syzygies occur between brachials 3 + 4, 6 + 7, 10 + 11 and 15 + 16.

P_1 is 22 mm. long, slender and evenly tapering, composed of 28 segments, of which the first is somewhat broader than long, the second is somewhat longer than broad, and those following slowly increase in length, so that the distal are about twice as long as broad. From the fourth onward the segments have a sharp ridge on the outer side, which is slightly convex in profile and finely and irregularly serrate. The area between this and the sharp ventral ridge is slightly concave.

P_2 is 18 mm. long with 27 segments and resembles P_1.

P_3 is 18 mm. long with 25 segments and resembles the pinnules preceding, as does P_4, which is 18 mm. long, with 26 segments.

P_5 is 19 mm. long with 28 segments and is very slightly stouter than the preceding pinnules.

P_6 is 20 mm. long with 27 segments and resembles P_5. The pinnules following are similar.

P_{25} is 17 mm. long with 27 segments.

The distal pinnules are exceedingly slender, 16 mm. long, with 30 segments, which are very slightly constricted centrally and have slightly serrate distal ends.

The colour in spirits is white with a broad, irregular, and frequently interrupted dorsal band of purple on the division series and arms. The cirri are more or less shaded or spotted with purple, the segments often with purple saddles or spots, and the distal pinnules are more or less blotched with purple.

The colours of the living specimen were noted as being as follows, compared with those of ' Color Standards and Color Nomenclature ' (Ridgway, R., 1912) : " Disc and arms : pale viridine yellow ; dorsal arm stripe : taupe brown."

Remarks.—This fine species is related to *T. afra*, which is found from northern Australia to southern Japan. It is much less stout, with much more slender arms and pinnules and longer brachials, which have more oblique ends. The slenderness and the relatively long brachials give it an appearance quite unlike that of any other species of the genus.

Tropiometra audouini A. H. Clark.

Tropiometra audouini, A. H. Clark, 1912*b*, p. 401 ; 1918, p. 131 (in key) ; 1932, p. 564.

Locality.—Station 53 ; South Arabian coast ; 13·5 metres. One specimen.

Range.—Red Sea, and eastward to Muscat.

Notes.—In the single specimen the cirri are about XX, 18–22. The carination of the arms is vestigial. The colour is dark purple, the division series and first eight or nine brachials with a narrow median yellow line, which beyond is interrupted. Some of the brachials have a narrow lateral longitudinal streak or spot of yellow. The cirri are purple, often with the segments narrowly yellow distally, especially on the ventral side.

Remarks.—The true status of this form is as yet undetermined. It is probably a local race of *T. carinata*.

Family Thalassometridæ A. H. Clark.

Crotalometra sentifera (A. H. Clark).

Thalassometra sentifera, A. H. Clark, 1912*c*, p. 201, fig. 37, p. 202.
Crotalometra sentifera, A. H. Clark, 1918, p. 149 (in key).

Locality.—Station 158 ; Maldive area ; 914 metres. Two specimens.

Range.—Laccadive and Maldive islands ; 914–1265 metres.

Notes.—One of the two specimens has 18 or 19 arms. The cirri are about 40 mm. long with 51–55 segments ; the eighth is a transition segment. On the centrodorsal the pairs of columns of cirrus sockets are separated in the midradial line by a broad and rather deeply concave bare area. The proximal edge of the IBr_1, the proximal and distal edges of the IBr_2 and the proximal edge of the $IIBr_1$ are everted and armed with a few short coarse spines.

The second specimen is similar, with 15 + arms. The longest cirri are 47 mm. long, with 61–63 segments. The transition segment is the eighth. The pairs of cirrus sockets are separated by a broad midradial space. The dorsal pole of the centrodorsal is papillose.

Remarks.—Except for the two above-mentioned specimens this species is known only from two much broken individuals dredged by the Royal Indian Marine Surveying Steamer " Investigator ".

Cosmiometra leilæ A. H. Clark.

Cosmiometra leilæ, A. H. Clark, 1932, p. 565, pl. 20, figs. 18, 19.

Locality.—Station 157 ; Maldive area ; 229 metres. Thirteen specimens.

Range.—From south of Ceylon to the Maldive Islands ; 199–241 metres.

Notes.—Thirteen specimens of this recently described species were dredged by the " Mabahiss ". In one of these the 23 arms are 95–100 mm. long. The cirri are XVIII, 36–39, 30–35 mm. long ; the transition segment is usually the ninth, sometimes the tenth. The division series resemble those of the two original specimens from south of Ceylon, but the elements of the IBr series are often somewhat rugose laterally, with the distal border of the IBr_1, and also the $IIBr_1$, coarsely scalloped laterally.

Another individual has 28 arms 90 mm. long. The division series have a slightly irregular surface.

In an example with 24 arms the dorsal surface of the division series is scarcely modified.

Other specimens have 25, 24, 23, 23, 20 and 15 arms, the last two being small. There are four additional examples.

A note made at the time of capture describes the colour of the specimens, compared with those of ' Color Standards and Color Nomenclature ' (Ridgway, R., 1912) to have been—" Orange with the aboral surface white ".

Remarks.—Heretofore this interesting species was known only from the two specimens dredged by the Royal Indian Marine Surveying Steamer " Investigator " south of Ceylon.

Thalassometra attenuata A. H. Clark.

Thalassometra attenuata, A. H. Clark, 1909*d*, p. 147 ; 1912, p. 204, fig. 38, p. 205 ; 1929, p. 654.

Locality.—Station 143 ; Maldive area ; 797 metres. One specimen.

Range.—Known from south of Karachi, the Maldive area, and off Mozambique ; 797–1398 metres.

Notes.—The arms of the single specimen were probably about 120 mm. long. The cirri are about 45 mm. long and consist of 55 segments, of which the ninth is a transition segment. The interradial pairs of columns of cirrus sockets are narrow, and are widely separated by a broad midradial, deeply concave bare area.

Remarks.—This species was originally described in 1909 from six specimens dredged by the Royal Indian Marine Surveying Steamer " Investigator " south of Karachi in 1398 metres. In 1929 a specimen was recorded that had been secured off Mozambique in 914 metres by the cable repair ship " Lady Denison-Pender " of the Eastern and Associated Telegraph Company. The specimen dredged by the " Mabahiss " represents the third record.

Suborder MACROPHREATA A. H. Clark.

Family Antedonidæ Norman (emended).

Repometra gen. nov.

Diagnosis.—A genus of Antedonidæ, subfamily Thysanometrinæ, in which P_2 resembles P_1 instead of P_3, and the cirri are short and composed of few segments that are not greatly longer than broad, with the distal laterally-flattened and dorsoventrally broadened.

Genotype.—*Repometra arabica* sp. nov.

Repometra arabica sp. nov. (Plate I, figs. 3, 3*a*.)

Locality.—Station 53 ; South Arabian Coast ; 13·5 metres. One specimen.

Description.—The centrodorsal is flattened hemispherical, about three times as broad as high, 1·8 mm. broad at the base, with the broad flat polar area 1·3 mm. in diameter. The cirrus sockets are arranged in three closely-crowded alternating marginal rows.

The cirri are about XXX, 10–12, from 3·7 to 5·0 mm. long. The first two segments are about twice as broad as long, the third is from one-third to one-half again as long as

the median width, and the fourth is about twice as long as the median width. The segments following become gradually shorter, so that the antepenultimate is from one-third to one-half again as long as broad, and the penultimate is about as long as broad. The opposing spine is minute, terminal, and directed outward. The terminal claw is about as long as, or slightly longer than, the penultimate segment, rather stout, and rather strongly and evenly curved, most strongly curved in the shorter cirri. The longer proximal cirrus segments are slightly constricted centrally. The distal half of the cirri is laterally flattened, so that in lateral view the outer half of the cirri is about twice as broad as the proximal half. The cirrus segments are all broadly rounded dorsally.

The radials are even with the edge of the centrodorsal. The IBr_1 are very short, seven or eight times as broad as long, with the proximal and distal edges parallel and the lateral edges strongly convergent and somewhat convex. The IBr_2 (axillaries) are triangular, from one-third to one-half again as broad as long, with the proximal border forming almost a straight line, the anterior edges concave, and the distal angle narrow and rounded at the apex. The lateral angles of the IBr_2 are separated from those of their neighbours by a distance equal to almost the entire width of the ossicle.

The 10 arms are all broken off at the base. The first brachials are wedge-shaped, about three times as long exteriorly as interiorly. The second brachials are irregularly quadrate, more than twice as broad as the median length ; they are somewhat larger than the first brachials. The first syzygial pair (composed of brachials 3 + 4) is broader than long, and is longer interiorly than exteriorly. The next two brachials are oblong, half again as broad as long, and those following are obliquely wedge-shaped, nearly as long as broad. The brachials beyond the fourth have prominent and very finely serrate distal ends.

Syzygies occur between brachials 3 + 4 and 9 + 10.

P_1 is 3 mm. long with 20 segments, which are about as long as broad, the outermost becoming somewhat longer than broad.

P_2 is about 1·7 mm. long with 12 segments and resembles P_1.

P_3 is 2 mm. long with about 13 segments, of which the first, second and third have a triangular dorsal process armed with spines directed obliquely distally, and the second–sixth bear a fusiform gonad.

The pinnules following are similar to P_3.

The colour is pale dull purplish, with a median white band on the division series and arms. The centrodorsal and cirri are white, the latter with broad light purple saddles on the segments, and a dark purple interrupted midventral line.

Remarks.—The single specimen of this species is much broken. However, the species is easily recognizable from the characters given. The subfamily Thysanometrinæ was heretofore known in the Indo-Pacific region only from the single genus *Thysanometra*. The discovery of a second genus in that region is therefore of considerable interest.

Psathyrometra mira A. H. Clark.

Psathyrometra mira, A. H. Clark, 1909*b*, p. 648 ; 1912*c*, p. 235, fig. 43 ; 1918, p. 227.

Locality.—Station 109 ; Zanzibar area ; 640 metres. One specimen.

Range.—From the Postillon Islands to the Andamans, and northward to the Gulf of Martaban ; off Zanzibar ; 338–794 metres.

Notes.—In the single specimen from Station 109 the midradial cirrus socket, between the proximal ends of the two columns, is lacking in two of the radial areas. The specimen is, however, undoubtedly referable to *Ps. mira*.

Caryometra robusta sp. nov. (Plate I, fig. 4.)

Locality.—Station 157 ; Maldive area ; 229 metres. One specimen.

Description.—The centrodorsal is conical with swollen sides and a flattened coarsely papillose dorsal pole, 2 mm. broad at the base and 1·5 mm. high. The cirrus sockets are arranged in three closely crowded columns of two each in each radial area, the median column sometimes consisting merely of a single socket. The sockets in each column alternate with those in the columns on either side. There is no differentiation of the surface of the centrodorsal into radial areas.

The cirri are about XXX, 39–47, 20 mm. long, rather stout and with the distal portion capable of being tightly coiled. The first segment is between three and four times as broad as long, the second is somewhat longer, the third is from half again to twice as broad as long, and those following gradually increase in length to the eighth–tenth (usually the ninth), a transition segment, which is twice as long as broad. The segments following slowly decrease in length so that the outermost are nearly or quite twice as broad as long. The distal dorsal edge of the transition segment is slightly prominent. This feature gradually increases in extent distally, developing, on the last eighteen segments, into a high thin median dorsal process with a broadly rounded crest arising from nearly or quite the entire dorsal surface of the segments. The opposing spine is prominent, long conical, arising from almost or quite the entire dorsal surface of the penultimate segment, its length equal to about half the width of that segment ; it is directed slightly forward. The terminal claw is about as long as the penultimate segment and is slender and moderately curved. As far as the middle or outer third of the transition segment the cirri are dark in colour, with a dull surface, beyond that point white with a highly polished surface.

The radials are short, between eight and ten times as broad as long, with a slightly concave distal edge, and are closely united laterally. In dorsal view at right angles to the arm the IBr_1 are somewhat over twice as broad as their lateral length. They are very deeply incised by a posterior process from the axillaries, so that in the median line they are about as long as the radials. In profile the dorsal surface is seen to extend directly outward at right angles to the axis of the arm. The IBr_2 (axillaries) are shield-shaped, about as long as broad, with an obtuse distal angle and proximally a long rounded swollen process deeply incising the IBr_1. Strongly developed synarthrial tubercles are present.

The 10 arms are 60 mm. long. The first brachials are twice as long exteriorly as interiorly, about twice as broad as the exterior length, and deeply incised by a posterior process from the second brachials, which are roughly shield-shaped, not greatly broader than long. The first syzygial pair (composed of brachials 3 + 4) is about half again as broad as long, and is slightly longer interiorly than exteriorly. The next four brachials are approximately oblong, nearly three times as broad as long, after which the brachials become triangular, about as long as broad, and soon very obliquely wedge-shaped and longer than broad, the length gradually increasing until distally they become about twice as long as broad, and terminally still longer. Beyond the third syzygy the

brachials are constricted centrally and have very finely serrate, though not produced, distal ends.

Syzygies occur between brachials 3 + 4, 9 + 10, and 14 + 15, and distally at intervals of 3 muscular articulations.

P_1 is 6 mm. long, with 12 segments, of which the first is about as long as broad, slightly trapezoidal, the second is about half again as long as broad, and those following are much elongated, becoming five or six times as long as broad distally. The third and following segments have moderately flaring and coarsely spinous distal ends.

P_2 is 5·7 mm. long with 11 segments and resembles P_1.

P_3 is 5 mm. long with 11 segments and resembles the pinnules preceding.

P_4 is 3·2 mm. long with 8 segments and resembles the earlier pinnules.

The colour in spirits is bright yellow, with the cirri beyond the transition segment white.

Remarks.—On the basis of the characters presented by the centrodorsal, cirri and arm bases this new species falls in the genus *Caryometra*, of which the only representative heretofore known, *C. tenuipes*, was dredged off Havana, Cuba, in 386 metres.

It differs markedly from *C. tenuipes* in being larger and stouter, with a shorter centrodorsal on which the cirrus sockets are not arranged so definitely in columns ; in having stouter cirri which have a strongly marked transition segment ; and in possessing strongly developed synarthrial tubercles.

Fariometra sewelli sp. nov. (Plate I, fig. 5.)

Locality.—Station 143 ; Maldive area ; 797 metres. One specimen.

Description.—The centrodorsal is conical with straight sides and a rather sharply rounded papillose apex, 3·5 mm. broad at the base, 2·5 mm. from the rim to the apex, and about 1·7 mm. high. The cirrus sockets are rather small and rather well spaced, evenly distributed in alternating rows. There are about four sockets under each radial.

The radials are even with the rim of the centrodorsal in the midradial line, but extend well up in the interradial angles, where their distal angles are separated by a notch. The IBr_1 are very short, about eight times as broad as the median length, with the distal edge slightly concave in the middle, rather strongly everted and armed with fine spines laterally. The lateral borders are somewhat convergent and slightly convex, and are widely separated from those of their neighbours. The IBr_2 (axillaries) are rhombic, with the two proximal sides slightly and the two distal sides strongly concave ; they are about half again as broad as long ; the distal angle is produced and narrow. The lateral angles of adjacent IBr_2 meet over the broad gap between the lateral borders of the IBr_1, forming a conspicuous pore. The anterior edges and the outer portions of the proximal edge are everted and finely spinous.

The 10 arms are about 50 mm. long. The first brachials are short, nearly or quite three times as broad as the outer (greater) length. The distal border is parallel to the proximal border from the inner distal angle to the midradial line, then turns outward and runs at an angle to the distal outer angle. The distal edge, except in the middle, is everted and finely spinous. The inner edges of adjacent first brachials are united in their proximal halves, the distal halves diverging at a right angle. The second brachials

are irregularly quadrate, slightly broader than long, much larger than the first brachials, with the distal edge thickened, everted, and finely spinous. The first syzygial pair (composed of brachials 3 + 4) is one-third again as long interiorly as exteriorly, with the proximal and distal edges somewhat, and the outer edge strongly, concave, the inner edge straight, and the distal edge thickened, everted, and armed with fine spines. The hypozygal is smaller than the epizygal. The next five brachials are slightly wedge-shaped, somewhat over twice as broad as the median length, somewhat constricted centrally, with produced and finely spinous distal ends. The brachials following are almost or quiet triangular and longer than broad. The distal edges of the brachials, though scarcely produced, are finely spinous.

Syzygies occur between brachials 3 + 4, 9 + 10 and 14 + 15, and distally at intervals of 2 muscular articulations.

P_1 is 10 mm. long with 22–23 segments, of which the first is rhombic, about twice as broad as long, and the next four are similar, slowly increasing in length, with the edge toward the arm tip produced into a high triangular process. The sixth segment is slightly longer than broad, without a carinate process. The segments following increase gradually in length, so that the outer are greatly elongated, about six times as long as the swollen ends. The pinnule is long and very slender, becoming filiform distally. The distal ends of the segments are produced and finely spinous.

P_2 is slightly stouter than P_1, 7 mm. long, with 14 segments, of which the first is rhombic, twice as broad as long, the second is almost triangular, about as long as broad, the third is slightly broader than long, the fourth is slightly longer than broad, and the fifth is half again as long as broad. The segments following are more slender, about three times as long as broad, becoming longer in the very slender distal segments. The third and following segments have everted and spinous distal ends. A large fusiform gonad occupies the entire inner border of the sixth–eighth segments.

Remarks.—This new species is related to *F. dione* from the Moluccas in 724 metres. It differs from *F. dione* in its lower and more sharply conical centrodorsal, the greater spinosity of the elements of the IBr series and lower brachials, and the occurrence of conspicuous triangular processes on the outer side of the earlier segments of P_1.

Family Pentametrocrinidæ A. H. Clark.

Pentametrocrinus varians (P. H. Carpenter).

Eudiocrinus varians, P. H. Carpenter, 1882, p. 496; 1888, p. 81, pl. 7, figs. 3–7; A. H. Clark, 1907, p. 569.
Pentametrocrinus varians, A. H. Clark, 1912*c*, p. 251; 1918, p. 262; H. L. Clark, 1923, p. 235.

Locality.—Station 135; Southern area of the Arabian Sea; 2727 metres. One specimen.

Range.—From southern Japan to the East Indies and westward to east Africa, from the Arabian Sea to South Africa; 660–2727 metres.

Notes.—In the single specimen from Station 135 the lower brachials are rather strongly constricted centrally with prominent ends. This feature, though not so strongly marked, occurs also in other specimens at hand from southern Japan.

Thaumatocrinus sp.

Decametrocrinus sp., A. H. Clark, 1912*c*, p. 248, fig. 47, p. 249.

Locality.—Station 158 ; Maldive area ; 914 metres. Fragments.

Notes.—The material consists of three fragments of arms. The longest, from the outer portion of an arm, is 60 mm. long and 2 mm. broad, and consists of 34 brachials, including 8 syzygial pairs, the latter being separated by 3 or 4 muscular articulations. The brachials are about half again as long as broad with strongly oblique ends, and are rather strongly excavated on the shorter side. The pinnule is attached to the middle of the longer side. Above the pinnule socket the side of the brachial is excavated for the reception of the pinnule when at rest. The pinnules bear along the ventral surface a linear series of small eggs, one to each segment.

Another fragment is 55 mm. long and 2·7 mm. wide at the base. On the eighteenth brachial from the base a short distal portion is regenerated, and on this is a pentagonal axillary bearing two arms, one 12 mm. long with 8 brachials, the other 17 mm. long with 11 brachials. The pinnules on the main portion of the arm are all moniliform ventrally, each bearing a linear series of eggs ; those on the two regenerated arm branches have not as yet developed eggs. The brachials in the main portion of the arm are very obliquely wedge-shaped, almost triangular, somewhat longer than broad, and slightly constricted centrally. The brachials in the two regenerated branches are much longer than broad. The intersyzygial interval is 4 muscular articulations.

The third fragment is a continuation of the left regenerated branch of the preceding. It is 17 mm. long and consists of 11 brachials.

The individual from which these fragments came was a female. The genital pinnules bear on the ventral side a linear series of entirely closed globular sacs, broadly in contact, and completely enclosed exteriorly by large thin plates, one to each segment, giving the ventral surface of the pinnules a moniliform appearance. The transverse septa between the sacs are very thin. Each sac contains a single large egg.

Remarks.—This specimen unquestionably is specifically identical with that represented by the fragments I described under the name of *Decametrocrinus sp.* in 1912. The latter were from " Investigator " Station 124, off the Laccadive Islands (lat. 10° 47′ 45″ N., long. 72° 40′ 20″ E.), in 1285 metres. By a curious coincidence each group of these fragments was dredged with two much broken individuals of *Crotalometra sentifera*. Also both sets of fragments show distal arm division.

Among the known forms the fragments approach most closely in their structure the species of *Thaumatocrinus*, but the structure of the gonads is unique, and it is probable that they will eventually prove to belong to a different, though related, genus.

List of the Crinoids Occurring Along the East Coast of Africa and Eastward to the Maldive Islands and the Persian Gulf.

Family Comasteridæ :

Comatella maculata (P. H. Carpenter) (A. H. Clark, 1911*a*, p. 16 ; 1913*b*, p. 3 ; 1931, p. 112 ; 1932, p. 552) ; Maldives ; Salomon ; Coin Peros ; ranges

eastward to Torres Straits and Bowen, Queensland, New Caledonia, Rotuma, the Caroline and Bonin Islands, and southern Japan ; 0–40 metres.

Capillaster sentosa (P. H. Carpenter) (A. H. Clark, 1913*b*, p. 4 ; 1931, p. 160) ; Maldives ; ranges eastward to the Lesser Sunda Islands, Western Australia, the Moluccas, the Philippines, and southern Annam ; 0–135 metres.

C. multiradiata (Linné) (A. H. Clark, 1913*b*, p. 5 ; 1931, p. 173) ; Maldives ; ranges eastward to Australia (south to Shark Bay on the west and Cape Flattery on the east), the Caroline and Philippine Islands, and Formosa ; 0–292 metres.

C. coccodistoma (P. H. Carpenter) (A. H. Clark, 1911*a*, p. 16, as *multiradiata* ; 1931, p. 212) ; Madagascar and Mauritius ; littoral.

Comissia hartmeyeri A. H. Clark (A. H. Clark, 1931, p. 267) ; Gulf of Suez ; littoral.

C. ignota A. H. Clark (A. H. Clark, 1931, p. 269) ; Seychelles and Amirante Islands ; littoral.

Comaster gracilis (Hartlaub) (A. H. Clark, 1913*b*, p. 12 ; 1931, p. 430) ; Maldives ; ranges eastward to New Britain, Fiji, and the Macclesfield Bank ; 0–55 metres.

Comanthina schlegelii (P. H. Carpenter) (A. H. Clark, 1931, p. 466) ; Maldives ; ranges eastward to northern Australia, the Caroline and Philippine Islands, and Macclesfield Bank ; 0–64 (? 278) metres.

Comanthus wahlbergii (J. Müller) (A. H. Clark, 1911*a*, p. 17 ; 1915, p. 166, pl. 9, fig. 3 ; 1931, p. 588 ; H. L. Clark, 1923, p. 231, pl. 8, fig. 3) ; South Africa from the Tugela River, Natal, to the Cape of Good Hope and Simons Bay ; 0–46 metres.

C. parvicirra (J. Müller) (A. H. Clark, 1931, p. 631) ; Madagascar ; Seychelles ; Mauritius ; Gwada, Baluchistan ; ranges eastward to Australia (south to Fremantle and Moreton Bay), New Caledonia, Fiji, Tonga, the Gilbert, Caroline, Pelew and Bonin Islands, southern Japan and Amoy, China ; 0–110 metres.

Family Eudiocrinidæ :

Eudiocrinus gracilis A. H. Clark (A. H. Clark, 1936, p. 301) ; Maldives ; ranges eastward to the Kei Islands ; 73–89 metres.

Family Himerometridæ :

Himerometra sol A. H. Clark (A. H. Clark, 1913*a*, p. 288 ; 1913*b*, p. 26 ; 1918, p. 73, in key) ; Maldives.

H. persica A. H. Clark (A. H. Clark, 1908, p. 243 ; 1913*a*, p. 289 ; 1918, p. 73, in key) ; Persian Gulf.

Heterometra ater (A. H. Clark) (A. H. Clark, 1911*a*, p. 21) ; Red Sea.

H. savignii (J. Müller) (A. H. Clark, 1911*d*, p. 251 ; 1911*a*, p. 24 ; 1913*b*, p. 27) ; Red Sea and eastward to Muscat ; 0–18 (? 22) metres.

H. producta (A. H. Clark) (A. H. Clark, 1913*b*, p. 23) ; Maldives ; ranges eastward to Singapore.

H. flora (A. H. Clark) (A. H. Clark, 1913*b*, p. 23) ; Maldives.

H. madagascarensis (A. H. Clark) (A. H. Clark, 1911*a*, p. 23) ; Madagascar.

H. reynaudi (J. Müller) (A. H. Clark, 1918, p. 79 ; 1929, p. 638) ; Maldives ; ranges eastward to Burma.

H. joubini A. H. Clark (A. H. Clark, 1911*d*, p. 251 ; 1911*a*, p. 25) ; Zanzibar.

H. gravieri A. H. Clark (A. H. Clark, 1911*d*, p. 251 ; 1911*a*, p. 25) ; Zanzibar.

H. africana (A. H. Clark) (A. H. Clark, 1911*a*, p. 20 ; 1913*b*, p. 24) ; Bagamoyo ; Zanzibar ; Waxin ; Karachi ; Persian Gulf ; 0–88 (? 89) metres.

Family Mariametridæ :

Stephanometra spicata (P. H. Carpenter) (see p. 88).

S. indica indica (E. A. Smith) (Chadwick, 1908, p. 45, as *marginata* ; A. H. Clark, 1911*a*, p. 26, as *marginata* and as *indica* ; 1911*d*, p. 252 ; 1913*b*, p. 29, in part [record for the Maldives is *protectus*]) (see p. 88).

S. indica protectus (Lütken) (see p. 88, under *indica*).

Lamprometra palmata (J. Müller) (A. H. Clark, 1929, p. 641 ; 1932, p. 557) ; Maldive Islands, Gwada, Baluchistan, and the " Arabian Sea " eastward to Torres Straits, the Solomon Islands, New Caledonia, the Tonga, Fiji, Hawaiian, Marshall and Caroline Islands, the Philippines, and Hong Kong ; 0–51 (? 433) metres.

L. klunzingeri (Hartlaub) (Chadwick, 1908, p. 46, as *imparipinna*, p. 47, as *palmata* ; A. H. Clark, 1911*a*, p. 26, as *protectus*, p. 27, as *palmata* and *klunzingeri* ; 1911*d*, p. 253, as *palmata* ; 1913, p. 33, as *palmata* ; 1929, p. 641 ; 1932, p. 558) (see p. 89).

Dichrometra flagellata var. *afra* A. H. Clark (Ludwig, 1899, p. 538 ; A. H. Clark, 1911*a*, p. 27, as *Dichrometra sp.*, p. 28, as *flagellata* ; 1911*d*, p. 254, as *Dichrometra sp.* ; 1913*b*, p. 31 ; 1929, p. 641 ; H. L. Clark, 1923, p. 232, pl. 8, fig. 2, as *Liparometra multicirra*) ; East Africa from Lamu, Kenya, south to Durnford Point, Zululand ; Madagascar ; 0–164 metres.

Family Colobometridæ :

Cenometra emendatrix (Bell) (Bell, 1892, p. 428, pl. 18 ; 1909, p. 20, as *spicata* ; A. H. Clark, 1911*a*, p. 28 ; 1913*b*, p. 33) ; Mauritius and the Seychelles ; 0–71 metres.

Colobometra arabica A. H. Clark (see p. 89).

Cyllometra manca (P. H. Carpenter) (A. H. Clark, 1909*d*, p. 146, as *soluta* ; 1912, p. 157, fig. 22, as *soluta* ; 1918, p. 115, in key, as *soluta*) ; from southern Japan and the Bonin Islands to the Philippine, Kei and Lesser Sunda Islands, and westward to the Persian Gulf ; 22 (? 15)–329 (? 731) metres.

Decametra chadwicki (A. H. Clark) (Chadwick, 1908, p. 44, as *serripinna* ; A. H. Clark, 1911*a*, p. 30 ; 1912, p. 168 ; 1918, p. 125, in key ; Boulenger, 1913, pp. 88, 102, as *serripinna*) ; Suez Bay ; 18 metres.

D. alaudæ A. H. Clark (A. H. Clark, 1911*a*, p. 33 ; 1913*b*, p. 35 ; 1918, p. 117, in key ; 1929, p. 642, pl. 44, fig. 14) ; Cargados Carajos ; 55 metres.

D. taprobanes (A. H. Clark) (A. H. Clark, 1909*b*, p. 641 ; 1913*b*, p. 36 ; 1918, p. 117, in key) ; Ceylon and the Maldive Islands ; 0–58 metres.

D. arabica A. H. Clark (A. H. Clark, 1912*c*, p. 161 ; 1913*b*, p. 36 ; 1918, p. 117, in key) ; Muscat ; littoral.

D. mollis (A. H. Clark) (A. H. Clark, 1909*c*, p. 76 ; 1912*c*, p. 161, fig. 24, p. 162 ; 1913*b*, p. 35 ; 1918, p. 117, in key ; 1929, p. 643) ; Karachi to the Maldive Islands ; littoral.

D. modica A. H. Clark (A. H. Clark, 1911*a*, p. 31, as *möbiusi*, p. 32 ; 1912*b*, p. 382 ; 1912*c*, p. 163 ; 1913*b*, p. 36, as *mœbiusi* ; 1918, p. 118, in key) ; Bagamoyo and Mauritius to the Maldive Islands ; ? Ceylon ; littoral.

Oligometra serripinna serripinna (P. H. Carpenter) (A. H. Clark, 1929, p. 646) ; from the Macclesfield Bank and the Philippine Islands southward to New Guinea and westward to the Pedro Shoal, the Maldive Islands, and Bagamoyo, Tanganyika Territory ; 0–91 (? 183) metres.

O. serripinna var. *electræ* A. H. Clark (A. H. Clark, 1911*a*, p. 51 ; 1912*c*, p. 174 ; 1913*b*, p. 38 ; 1918, p. 129, in key) ; southeast of Massawa, Eritrea ; 38 metres.

O. serripinna var. *occidentalis* A. H. Clark (see p. 90).

Family Tropiometridæ :

Tropiometra magnifica A. H. Clark (see p. 90).

T. carinata (Lamarck) (A. H. Clark, 1911*a*, p. 34 ; p. 35, as *picta* ; 1911*d*, p. 255, as *carinata* and as *picta* ; 1913*b*, p. 39, p. 40, as *picta* ; 1932, p. 564) ; Cargados Carajos, the Seychelles, Farquhar Atoll, Mauritius, Madagascar and Réunion, and the African coast southward and westward to False Bay, Cape of Good Hope ; St. Helena ; from Santa Catarina Island, southern Brazil, northward to St. Lucia, Tobago, Trinidad and Venezuela ; 0–55 metres, but brought up from 508 metres off St. Lucia.

T. audouini A. H. Clark (A. H. Clark, 1911*a*, p. 36, as *encrinus*, in part ; 1929, p. 646 ; 1932, p. 564) (see p. 92).

Family Thalassometridæ :

Crotalometra sentifera (A. H. Clark) (see p. 92).

C. magnicirra (Bell) (A. H. Clark, 1911*a*, p. 36) ; off East London ; 548–823 metres.

Cosmiometra leilæ A. H. Clark (see p. 92).

C. gardineri A. H. Clark (A. H. Clark, 1911*a*, p. 38 ; 1913*b*, p. 43) ; Saya de Malha ; 247 metres.

Thalassometra attenuata A. H. Clark (see p. 93).

Thalassometra sp. nov. (A. H. Clark, 1911*a*, p. 51 ; 1913*b*, p. 70) ; northwest of Sokotra ; 2194 metres.

Family Charitometridæ :

Perissometra occidentalis A. H. Clark (A. H. Clark, 1929, p. 655, pl. 42, fig. 10) ; 120 miles off the Seychelles ; 1462 metres.

Pachylometra sclateri (Bell) (A. H. Clark, 1911*a*, p. 38 ; 1913*b*, p. 48 ; 1918, p. 184, in key, p. 185 ; H. L. Clark, 1923, p. 234) ; off East London, South Africa ; 238 (? 146)–566 metres.

Pachylometra sp. nov. (A. H. Clark, 1911*a*, p. 51 ; 1913*b*, p. 70); northwest of Sokotra ; 2194 metres.

Family Antedonidæ :

Compsometra parviflora A. H. Clark (A. H. Clark, 1918, p. 207 ; 1936, p. 316) ; Maldives and eastward to the Moluccas and the Philippines ; 0–275 (? 400) metres.

Dorometra mauritiana (A. H. Clark) (A. H. Clark, 1911*a*, p. 40 ; 1911*d*, p. 257 ; 1912, p. 405 ; 1918, p. 216) ; Madagascar and Mauritius ; littoral.

D. nana (Hartlaub) (A. H. Clark, 1913*b*, p. 54 ; 1918, p. 215, in key, p. 216) ; Maldives and eastward to northern Australia, the Tonga Islands, the Philippines and Macclesfield Bank ; 0–74 metres.

D. ægyptica (A. H. Clark) (Chadwick, 1908, p. 45, as *parvicirra* ; A. H. Clark, 1911*a*, p. 42 ; 1913*b*, p. 53 ; 1918, p. 215, in key, p. 217) ; Suez Bay ; 18 metres.

Annametra occidentalis (A. H. Clark) (A. H. Clark, 1915, p. 164, pl. 10, figs. 1–5 ; 1929, p. 659 ; H. L. Clark, 1923, p. 231) ; from Durban, Natal, southward and westward to Simons Bay, Cape of Good Hope ; littoral.

Repometra arabica A. H. Clark (see p. 93).

Psathyrometra mira A. H. Clark (see p. 94).

Caryometra robusta A. H. Clark (see p. 95).

Perometra afra A. H. Clark (A. H. Clark, 1911*a*, p. 43 ; 1913*b*, p. 57 ; 1918, p. 234) ; Providence Island, northeast of Madagascar ; 228 metres.

Cyclometra flavescens A. H. Clark (A. H. Clark, 1911*a*, p. 51 ; 1913*b*, p. 62) ; northwest of Sokotra ; 2194 metres.

Fariometra sewelli A. H. Clark (see p. 96).

Thaumatometra sp. nov. (A. H. Clark, 1911*a*, p. 51 ; 1913, p. 71) ; northwest of Sokotra ; 2194 metres.

Family Pentametrocrinidæ :

Pentametrocrinus varians (P. H. Carpenter) (see p. 97).

Pentametrocrinus sp. (Chun, 1900, p. 488, as *Eudiocrinus*, sp. nov. ; A. H. Clark, 1911*a*, p. 49) ; off Somaliland ; 1289 metres.

Thaumatocrinus sp. A. H. Clark (see p. 98).

Family Bathycrinidæ :

Bythocrinus chuni (Döderlein) (Chun, 1900, p. 488, as *Rhizocrinus sp.* ; Döderlein, 1907, p. 14, fig. 6, pl. 1, fig. 5, pl. 6, fig. 6 ; 1912, p. 14, pl. 3 ; H. L. Clark, 1923, p. 229) ; from Somaliland southward to South Africa ; 1644–1828 metres.

Monachocrinus cœlus H. L. Clark (H. L. Clark, 1923, p. 229, pl. 8, fig. 1) ; South Africa ; 1645–1828 metres.

[Note.—*Antedon impinnata* P. H. Carpenter from Mauritius is an immature individual that has not yet acquired the full complement of proximal pinnules. The species cannot be determined from the meagre description.]

The Fauna of the Indian Ocean and the Red and Arabian Seas.

From the Indian Ocean west of Ceylon and the west coast of India, and the Arabian and Red Seas, there have been recorded 69 species and forms of crinoids, which are distributed among the several families as follows: Comasteridæ, 10; Eudiocrinidæ, 1; Himerometridæ, 11; Mariametridæ, 6; Colobometridæ, 12; Tropiometridæ, 3; Thalassometridæ, 6; Charitometridæ, 3; Antedonidæ, 12; Pentametrocrinidæ, 3; and Bathycrinidæ, 2.

No representatives of the families Zygometridæ, Calometridæ, Ptilometridæ, Asterometridæ, Notocrinidæ, Atelecrinidæ, Pentacrinidæ, Proisocrinidæ, Phrynocrinidæ, Hyocrinidæ or Holopodidæ, or of the subfamily Comactiniinæ of the Comasteridæ or of the subfamily Heliometrinæ of the Antedonidæ, have been taken in this area.

It is probable that the Zygometridæ and Comactiniinæ, including shallow-water types usually common in the regions where they occur, are really absent. The polar and east Pacific Heliometrinæ, the south Australian Ptilometridæ, the Antarctic Notocrinidæ and the Caribbean Holopodidæ also probably do not occur. Representatives of the Calometridæ, Atelecrinidæ, Pentacrinidæ, Proisocrinidæ, Phrynocrinidæ and Hyocrinidæ, and possibly of the Asterometridæ, will probably be found as the region becomes better known.

The crinoid fauna of the Indian Ocean is simply the progressively depauperate western extension of the very rich fauna that has its centre in the region of the large Malayan islands. This fauna extends northward along the western side of the Malay peninsula, and also reaches the Andaman Islands. Thence it extends across the Bay of Bengal to Ceylon, where, however, a number of its characteristic elements appear to be missing. West of Ceylon it reaches, in a still more attenuated form, the Maldive Islands, where no less than twelve wide ranging Malayan types reach their western limit. These are:

Capillaster sentosa.
Capillaster multiradiata.
Comaster gracilis.
Comanthina schlegelii.
Eudiocrinus gracilis.
Heterometra producta.
Heterometra reynaudi.
Stephanometra protectus.
Lamprometra palmata.
Decametra taprobanes.
Compsometra parviflora.
Dorometra nana.

Together with these should be grouped *Himerometra sol*, *Heterometra flora*, *Decametra mollis*, *Crotalometra sentifera*, *Cosmiometra leilæ* and *Fariometra sewelli*, all of which are obviously closely related to forms found further east.

It was, on the other hand, in this region of the Indian Ocean that the John Murray Expedition found a representative of the genus *Caryometra* previously known only from the Caribbean Sea (see p. 96), a discovery especially interesting in view of the recent description of *Psathyrometra acuta*, dredged off Puerto Rico, allied to *Ps. mira*, and representing a genus supposed to be confined to the Indo-Pacific region and the west coast of North and Central America.

In the Persian Gulf we find *Himerometra persica*, of which the Malayan *H. bartschi* is probably only a larger form, and the wide-ranging *Cyllometra manca*. The Persian Gulf may therefore be considered as the western limit of the Malayan fauna in the Arabian Sea, corresponding in this respect to the Maldive Islands further south.

Southwestward from the Maldive Islands the Malayan fauna, becoming still more attenuated, reaches the Seychelles, Rodriguez, Mauritius, Réunion, Madagascar and the opposite coast of Africa. A definite modification is now evident. The few endemic species are either small and slender, with slender proximal pinnules, or they are small, slender, and slender-pinnuled representatives of typically larger and stouter types. In most cases they differ more or less widely from the corresponding, or most closely related, forms occurring further eastward. But the differences are due to further depauperization. No new faunal types appear. Here we find :

Comatella maculata.
Capillaster coccodistoma.
Comissia ignota.
Comanthus parvicirra.
Heterometra madagascarensis.
H. joubini.
H. gravieri.
H. africana.
Stephanometra indica.
Dichrometra afra.
Cenometra emendatrix.
Decametra alaudæ.
D. modica.
Oligometra serripinna.
O. occidentalis.
Tropiometra carinata.
Cosmiometra gardineri.
Perissometra occidentalis.
Dorometra mauritiana.
Psathyrometra mira.
Perometra afra.

North of Zanzibar and west of the Persian Gulf the fauna becomes still more attenuated. Species are few and individuals apparently localized and uncommon—at least no large number of individuals of any species has ever been secured anywhere. The local forms are all slender and usually small representatives of corresponding Malayan types, and all are remarkable for their slender proximal pinnules. All of them differ from their immediate relatives at Ceylon or further eastward, though some of them—*Stephanometra indica, Oligometra occidentalis, Thalassometra attenuata* and *Bythocrinus chuni*—occur in the region between the Maldive Islands and south-eastern Africa. The inclusion in the following list of *Stephanometra spicata* and of *Pentametrocrinus varians* is no real exception to this statement, for the single specimen of each in the collection differs in certain particulars, quite likely to prove of varietal or subspecific importance when additional material is available, from typical examples from the Malayan area. The forms occurring in this region are :

Comissia hartmeyeri.
Heterometra ater.
H. savignii.
Stephanometra spicata.
S. indica.
Lamprometra klunzingeri.
Colobometra arabica.
Decametra chadwicki.
D. arabica.
Oligometra electræ.
O. occidentalis.
Tropiometra magnifica.
T. audouini.
Thalassometra attenuata.
Thalassometra sp.
Pachylometra sp.
Dorometra ægyptica.
Repometra arabica.
Cyclometra flavescens.
Thaumatometra sp.
Pentametrocrinus varians.
Pentametrocrinus sp.
Bythocrinus chuni.

Of the forms included in the preceding list *Repometra arabica* and *Cyclometra flavescens* are both known only from single individuals, and both represent genera known nowhere else. They would appear, therefore, to contradict the statement that no new faunal types appear in this region. *Repometra arabica* is very small. Crinoids so small as this are seldom recovered from the material brought up by the dredge. It should be disregarded in a discussion of faunal relationships. *Cyclometra flavescens* was brought up from very deep water together with *Thalassometra sp.*, *Pachylometra sp.*, and *Thaumatometra sp.* With these wide-ranging associates, the genus *Cyclometra* cannot be assumed to be absent from the seas further east ; indeed, it is rather closely related to the Japanese *Boleometra clio*, which until recently was included in *Cyclometra*.

South Africa, from Natal southward and including the south-western coast as far north as Saldanha Bay, has a fauna of its own characterized by two distinctive elements. The crinoids known from this region are :

Comanthus wahlbergii.
Tropiometra carinata.
Crotalometra magnicirra.
Pachylometra sclateri.
Annametra occidentalis.
Pentametrocrinus varians.
Bythocrinus chuni.
Monachocrinus cœlus.

Comanthus wahlbergii shows the closest affinity with *C. trichoptera*, *C. benhami*, *C. tasmaniæ* and *C. novæzealandiæ* of southern Australia, Tasmania and New Zealand. It is quite different from any of the Indo-Pacific species of the genus. *Annametra occidentalis* has as its only close relative the very different *A. minuta* of southern Japan.

Pentametrocrinus varians is a wide-ranging Indo-Pacific species, and *Crotalometra magnicirra* and *Pachylometra sclateri* are local species of wide-ranging deep-water Indo-Pacific genera. *Bythocrinus chuni* and *Monachocrinus cœlus* are local representatives of genera widely distributed both in the Indo-Pacific region and in the Atlantic.

Tropiometra carinata offers a most interesting faunal anomaly. It occurs among the islands in the western Indian Ocean, from Kenya southward to the Cape of Good Hope, at St. Helena, and from southern Brazil northward to Venezuela and the southern West Indies. It is everywhere littoral, except at St. Lucia. Like so many wide-ranging animals, it is usually common, or even abundant, wherever it is found. It is equally abundant at Mauritius, Zanzibar, Rio de Janeiro, Tobago and St. Lucia, in all of these places being by far the commonest crinoid. It is very common at other localities also. It is the only crinoid common to the islands in the western Indian Ocean, south-eastern and southern Africa, St. Helena, and the western tropical Atlantic. Its range does not coincide with any faunal region as delimited by other littoral crinoids, but extends over three more or less distinct faunal regions. Closely related to this, perhaps merely local forms of it, are *T. audouini* of the Red Sea region, *T. indica* of Ceylon, and the larger *T. encrinus* of the eastern coast of India. The two other species of the genus are the very large and stout *T. afra* occurring from southern Japan to Australia, and the almost equally large, but curiously slender, *T. magnifica* from the Gulf of Aden.

Stated briefly, the faunal conditions in the Indian Ocean, so far as the littoral and shallow-water crinoids are concerned, are these : The Malayan fauna, little changed except for the absence of a number of characteristic species, extends across the Bay of Bengal to Ceylon and, with the loss of additional species, to the Maldive Islands and the Persian Gulf. Becoming still more attenuated, the Malayan fauna extends south-westward along

the islands of the western Indian Ocean to south-eastern Africa. In this region all the large species are absent and many of the others have become modified in the direction of a decrease in size and stoutness, combined with greater slenderness of the proximal pinnules. North of Zanzibar and Madagascar and west of the Persian Gulf the fauna becomes still poorer. The relatively few local forms, all of which appear to be uncommon, are all slender and usually small representatives of corresponding Malayan types. All of them differ from their relatives occurring in Ceylon and further eastward, though some live among the islands to the southward.

South Africa from Natal southward has its own special fauna, characterized by two littoral endemic species that are quite different from any Malayan forms. The third littoral species ranges north-eastward to Cargados Carajos, but the group of species to which it belongs is not represented east of Ceylon and the eastern coast of India.

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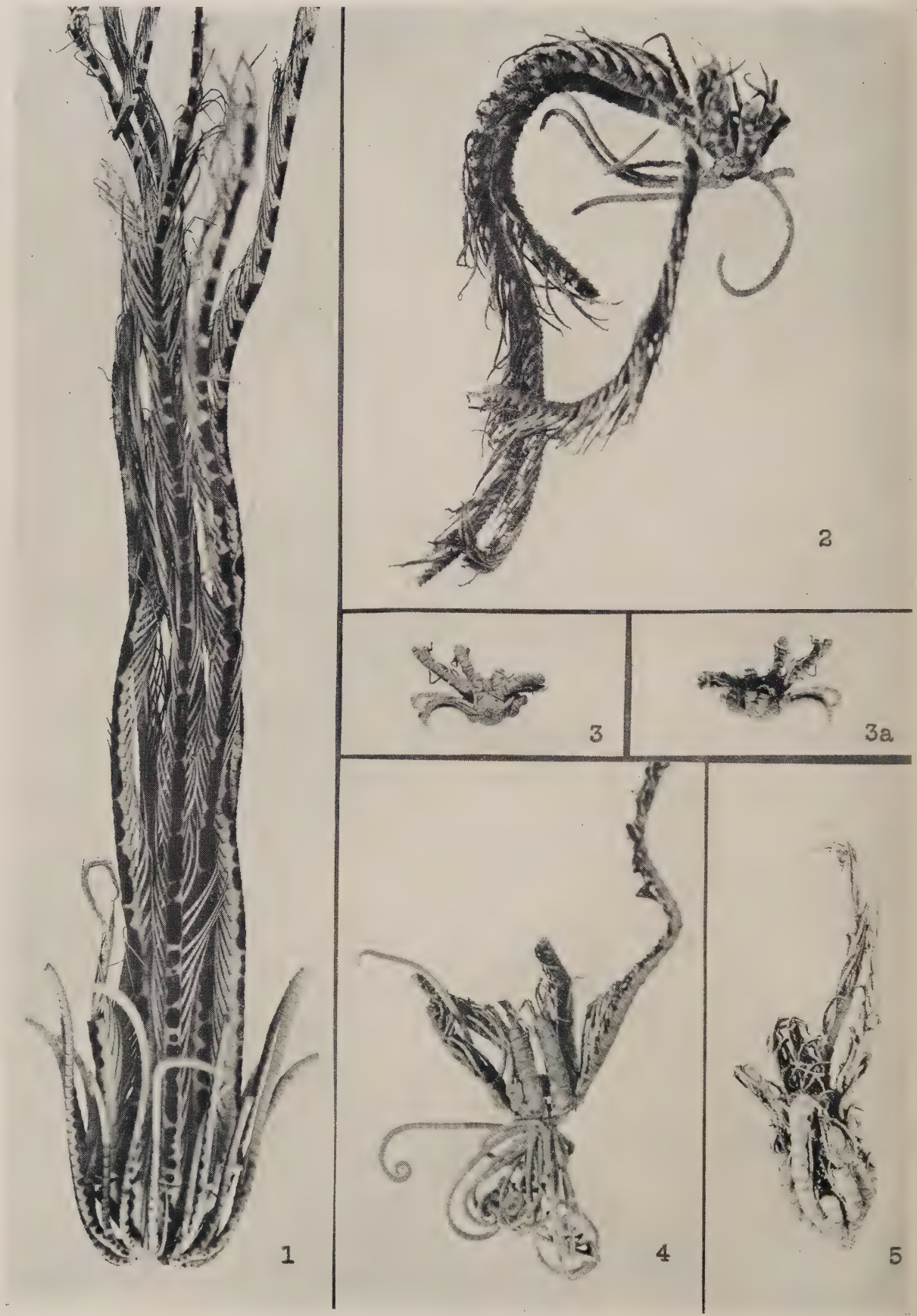

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DESCRIPTION OF PLATE I.

Fig. 1.—*Tropiometra magnifica* sp. nov., from Station 24, Gulf of Aden, 73–220 metres. Natural size.

Fig. 2.—*Colobometra arabica* sp. nov., from Station 10, Red Sea, 55 metres. × 2.

Figs. 3, 3*a*.—*Repometra arabica* gen. et sp. nov., from Station 53, South Arabian coast, 13·5 metres. × 3.

Fig. 4.—*Caryometra robusta* sp. nov., from Station 157, Maldive area, 229 metres. × 3.

Fig. 5.—*Fariometra sewelli* sp. nov., from Station 143, Maldive area, 797 metres. × 2.